

Backwater hydrodynamics and sediment transport in the lowermost Mississippi River delta: Implications for the development of fluvial-deltaic landforms in a large lowland river

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Abstract Where rivers enter the coastal zone, gradually varying non-uniform flow conditions develop in the channel. This section of the river is referred to as the backwater segment, and for large rivers, backwater flow extends many hundreds of kilometres upstream of the river outlet. Studies from the Mississippi River document a persistent backwater zone that influences sediment mobility throughout the lowermost 500 km of the river. Reach-average shear stress varies temporally in accordance with the annual hydrograph, affecting the timing, magnitude, and grain size of transported sediment. A net reduction in shear stress restricts the downstream movement of coarse sediment, and this portion of the river's sediment load does not reach the coastline. Instead, coarse sediment is caught at the backwater transition and is sequestered in the river channel. Information about the timing and magnitude of sediment flux in the backwater segments of large rivers is critical to addressing the landscape dynamics of deltas. Research from the Mississippi River delta, where roughly 5000 km² of land has been converted to open water in the past century, is presented as a case study. The collapse of the Mississippi River delta is driven by rapid land subsidence associated with the extraction of subsurface fluids, eustatic sea-level rise, and the construction of levees, which prevent the movement of sediment to the neighbouring flood plain. Recent studies have demonstrated that current sediment loads in the Mississippi River are sufficient to offset much of the future land loss, if measures are undertaken to extract sediment for delta building. Local conditions favour the development of channel bars and such locations are optimal for river diversions that deliver sediment to the surrounding delta. Studies from the Mississippi River delta can be extended to other large river-delta systems around the world to assess appropriate measures for sustaining delta landscapes.

Key words sediment transport; river-delta stratigraphy; backwater hydrodynamics